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May 1, 2012

ELECTRONIC FILING

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: *Ex Parte*, WT Docket No. 10-4

Dear Ms. Dortch:

The attached letter from Michael Rodgers, Founder and CTO of Wireless Extenders, Inc., responds to questions from FCC staff relevant to the above-captioned proceeding.

Respectfully,



Devendra T. Kumar
Attorney for Wireless Extenders, Inc.

cc: Roger Noel
 Joyce Jones
 Becky Schwartz
 Moslem Sawez
 Tom Derenge

May 1, 2012

VIA ELECTRONIC FILING

Moslem Sawez
Wireless Telecommunications Bureau
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: WT Docket No. 10-4

Dear Mr. Sawez:

The following letter responds to questions from you and other FCC staff regarding the magnitude of delay through wideband boosters offered by Wireless Extenders, Inc. ("Wi-Ex").

From its founding, Wi-Ex has maintained a solid commitment to improving the overall quality and usability of mobile phone signals to benefit both the carrier (service provider) and the mobile user (their customer). Our line of zBoost products are effective at Extending Cell Zones — bringing the outdoor signal quality into the indoor areas where mobile users want it by overcoming common signal barriers, while remaining transparent to carrier network equipment and with minimal delay. Wi-Ex carefully engineers its products, including patented and patent-pending technology, to maximize our end-users' satisfaction and ease-of-use, while also preventing interference to carrier networks.

The primary motivation for developing zBoost was to meet the growing need of consumers who are frustrated by a lack of usable signal in many places that they need and expect to use the mobile communication service that they pay for. In many of these places, mobile location accuracy becomes an issue only after products like zBoost enable the primary ability to make and hold any usable call in the first place, including for any unfortunate emergency situations.

Wi-Ex has focused on wideband boosters because they are the most effective and efficient method available to meet the needs of the customer of the mobile service providers. These reasons include the low delay and the resultant negligible impact upon mobile handset location technologies. Other reasons for Wi-Ex's focus on wideband boosters are because they are easy for most people to select and setup, they boost multiple carriers' signals for multiple users simultaneously, they provide greater consumer choice when selecting or changing carrier service, and because they offer the best value (lowest cost per square foot of coverage per carrier). In short, wideband boosters are both the most advantageous in terms of their negligible impact on mobile handset location technologies as well as the most consumer friendly coverage solution available.

Questions posed by FCC personnel:

1. *What is the duration of the signal delay introduced by currently-manufactured signal boosters?*

Current Wi-Ex boosters introduce a maximum of about 240ns (nanoseconds) of total signal delay in the PCS1900 band and about 180ns in the cellular CEL850 band. Our lower gain products (e.g. the mobile zForce booster which also mounts and charges your smartphone in a cradle for the car) require less filtering and, thus, have much lower delay. In contrast, narrow-band devices, such as block-specific repeaters, typically specify a total delay of 2,000-3,000ns (2-3us). Solutions which are carrier-specific (block-specific) and that also eliminate the coaxial cable used to couple the exterior antenna to the booster unit by using an alternate [unlicensed] RF band have even higher delays.¹

2. *Is the delay taken into consideration in the design phase of the signal booster?*

The delay and potential impact to E9-1-1 location was a specific consideration in choosing to develop wideband boosters and in their design. Wi-Ex measured and monitored the delay through the first several products as well as the delay of the individual filters evaluated for these products; however, because the total delay is so low and so much less than typical multipath delay, it is not a primary driving concern for new wideband designs.

3. *If so, are there specific goals for minimum delay and maximum delay?*

The Wi-Ex goal for zBoost products is to introduce much less delay than typical multipath found in cellular communication links and we meet our goal.

4. *What specifically causes the delay?*

Each amplifier component adds about 2-5ns of delay, but the biggest contributors are the filters. Full-band RF filters can have roughly 15 to 40ns of delay each. In contrast, narrow-block IF filters, required by carrier-specific boosters, can have between 700 to 2,000ns of delay each. Digital filters can have more or less delay, depending upon the tradeoffs chosen between performance, delay, and cost. Coaxial cable also introduces delay; however, this effect is largely nullified by the normal delay for the signal to exit the structure without a booster present. Coaxial cable delay is typically 20% more than the delay through air (e.g. a 50 foot coax has a typical delay of 60ns).

¹ For example, Nextivity specified the delay of their products at 7.2 or 13.6 us (7,200 or 13,600 ns). See Nextivity, Inc. Response to Request for Information, *Ex Parte* filing in WT Docket No. 10-4, at 2 (Mar. 8, 2012).

5. A Location Measurement Unit (LMU) at the cell site may select the signal booster signal, which has a built-in delay instead of the mobile phone signal, therefore causing a location inaccuracy. Can signal boosters use digital watermarking, i.e., signals that can be identified at the LMU as those of a signal booster, to prevent their signal from being used for location measurements?

While zBoost wideband boosters add an additional multipath component, its delay is less or similar to other components of multipath, which is already addressed by the LMU. Significantly, for fixed location boosters, since the network side (donor) antenna is mounted outside and most often above or near the roofline, the remaining path to the BTS is LESS obstructed and, therefore, reduces some other multipath elements which are introduced without a booster. In many situations, the boosted signal will be desirable to the LMU, even when slightly delayed. Other repeaters, such as carrier-specific, narrow-block devices do have much higher delay and thus more location inaccuracy. These types of coverage boosters may need location improvements that may be achievable with watermarking or other techniques.

While it is certainly possible to devise a method using digital (or analog) watermarking or some other technique, the additional time, costs, and the necessary network validation testing would likely receive a low-priority among the other current challenges in E9-1-1 location circles. For example, some studies have shown that A-GPS to have gross inaccuracies (over 500 meters) in multi-floor buildings. Given the negligible delay and location inaccuracy introduced by wideband boosters, and given the other, more significant challenges faced by emergency location technologies in urban and other settings, the wireless industry's resources need not be expended on developing and implementing a watermarking solution for products such as wideband boosters that do not result in anything more than negligible location inaccuracy.

6. What are the pros and cons of digital watermarking?

Watermarking may only be relevant to carrier-specific boosters. See number 5 above.

As we have illustrated both herein and in prior filings,² Wi-Ex has been thoughtful and intentional in our development of signal boosters regarding E9-1-1 location and has taken steps to mitigate these and other types of potential network interference. Wi-Ex was planning, testing, and designing protection mechanisms into our products before

² See *Ex Parte* Letter filed by Wireless Extenders, Inc., Oct. 14, 2010, WT Docket No. 10-4.

selling our first units at the end of 2004, and has been a pioneer and the industry leader in developing technical solutions such as anti-oscillation solutions to prevent interference to wireless carrier networks.

Wi-Ex has always been mindful of the need to use mobile communication in emergency situations and has engineered zBoost to facilitate and improve all cellular-type communications. zBoost wideband boosters introduce a very low delay component which is a fraction of the total multipath delay when zBoost is not present. Network changes are not needed when considering zBoost wideband boosters and their many benefits are available today to both the service carriers and to their customers. It is also important to remember that the low delay and negligible emergency location inaccuracy introduced by wideband boosters is far, far outweighed by the fact that wideband boosters such as zBoost enable all types of wireless calls, including emergency calls, in many situations and indoor locations in which such calls would not otherwise be possible.

Please do not hesitate to contact me if you have any questions.

Michael Rodgers
Founder and CTO
Wireless Extenders, Inc.

CC: Roger Noel
Joyce Jones
Becky Schwartz
Tom Derenge